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BREAKOUT!

AT LAST pesticide manufacturers have decided to answer their critics, a policy which we have advocated since our origin. But why have these unjust accusations been unanswered in the past, why have the manufacturers and users allowed a small flame to build up into a forest fire before seeking to quench the flame? Why? Perhaps the industry and their customers, knowing that the accusations levelled at the use of chemicals in agriculture were exaggerated and wide of the mark, believed that the scare-mongers would meet a similar fate to Hilaire Belloc's Matilda—they would be consumed by the intensity of their own fire.

However, when such supposedly sane and respected members of the community as doctors and Members of Parliament begin to condemn the use of chemicals in agriculture and label the farmers as " broadcasters of scientific death " it is obvious that there is something radically wrong. So far, only those immediately concerned have had the opportunity to learn of the hazards involved and the stringent precautions taken to safeguard the public and wildlife. Yet the population is dependent upon agriculture for its existence. Who can blame them, especially the city dweller coming into contact with the agricultural world only during his annual holiday or on the odd weekend jaunt, for being worried when the only accounts of the use of chemicals in agriculture that they hear are in the form of scathing attacks published under headings such as " Beware the Killer on the Land". The true facts concerning the hazards of agricultural chemicals must not be confined to the industry and farmers alone, they must be diseminated as widely as possible to assure the public that they are not being poisoned.

Now there is evidence, in the form of statements made by the chairman of A.B.M.A.C., Mr. H. G. Huckle, and Dr. E. F. Edson, medical officer of Fisons Pest Control, that the tide is changing, the critics are to be answered. We have published Mr. Huckle's statement in full on page 93, not because our readers are ignorant of the facts but because we believe that it will provide them with some more evidence that they can use to educate the uninitiated.

It was pleasing to note that the statements of Mr. Huckle and Dr. Edson were given an airing in the " New Scientist " a publication which has given interest to the writer since its origin. The " New Scientist " has an admirable reputation and is read by people in various walks of life from sixth formers to technicians in industry and university professors. The inclusion of the industry's point of view in such a publication should be of great value in dispelling the outrageous beliefs held by one or two of the workers in other branches of science.

A small start has even been made to present favourable evidence to that large section of the public whose only source of information is the daily newspaper. On the 27th January, the " Evening Standard " published a report, compiled by one David Henshall, of Dr. Edson's statement putting the hazards, arising from the use of pesticides, into their true perspective. For anyone wishing to trace this report, it goes under the unfortunate heading of " How much poison does farming put in your food". Nevertheless it is a start in the right direction.

P.S.—We admit to having plugged this subject more than a disc jockey plugs his favourite record. We hope that it will not be necessary in the future.

A Concentration-Time Product Indicator for Fumigations

by

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and
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"The effectiveness of the treatment against insects and mites at a particular point has been found to be related to the integrated product of the concentrations and the time, the c.t. product. It is therefore of great value in assessing the effectiveness of treatments to measure c.t. products at selected points." In the following account the authors describe a simple method for the determination of the c.t. product.

Introduction

IN most commercial fumigations of buildings, or ships, or of stored produce, considerable variation in fumigant concentration occurs from one place to another throughout the treatment. The effectiveness of the treatment against insects and mites at a particular point has been found to be related to the integrated product of the concentrations and the time, the c.t. product. It is therefore of great value in assessing the effectiveness of treatments to measure c.t. products at selected points. Hitherto this has been done by determination of concentrations at intervals throughout the treatment, samples of air being withdrawn through lengths of fine-bore tubing and analysed either chemically or by means of instruments.[1] In general, only specialist investigators have been prepared to undertake such work. A simple direct method of determining the c.t. product or some related quantity at a selected point could be of great value to fumigators and others concerned with fumigation.

In the related field of microbial sterilisation by gaseous means, a simple sachet device to do this has recently been described in connection with ethylene oxide sterilisation.[2] The principle is applicable to many other gas treatments, and this paper describes the modification of the device to fumigation conditions with methyl bromide and ethylene oxide, and the tests carried out with such devices.

The device consists of a small gas-permeable plastic sachet containing a suitable absorbent for the gas, with if possible a suitable indicator. After the absorption of a certain quantity of gas the indicator changes colour. By variation of the dimensions, thickness etc. of the envelope, or the quantity or strength of the absorbent solution, the colour change can be produced after the absorption of any desired c.t. product of the gas at any particular temperature.

It is not always possible to use an internal indicator for all gases. However, it is usually possible to produce a suitable pre-packed reagent that will give the desired indication. Whilst this is not so convenient as the internal indicator, nevertheless the sachet plus pre-packed reagent constitutes a simple field test kit, which is easily used by the fumigant operator.

Although different insect species vary widely in their resistance to a particular fumigant and although the

TABLE I

Relationship between Temperature and Required c.t. product of Methyl Bromide

Temperature (°C.)	Methyl Bromide c.t. product mg. hr./litre
10	200
15	180
20	150
25	100
30	70

effect of temperature on resistance is also variable, it has been possible in certain instances to drive a relationship between the c.t. product required for general insect control and temperature. Usually, within the normal range of fumigation temperatures, an increase in temperature allows the use of a lower c.t. product for the same toxic effect. Thus, for methyl bromide, estimates have been published of the minimum c.t. products giving at least 99.9% kill of a variety of insect species at different temperatures[3] (Table I). These estimates have provided a useful working basis for judging the effectiveness of treatments in which c.t. measurements have been made.

The rate at which a gas diffuses through a permeable membrane increases with temperature. Hence a sachet which gives a positive result with a certain c.t. product at a certain temperature will give a positive result at a lower c.t. product if the temperature is raised, and conversely will require a greater c.t. product to give the positive result if the temperature is lowered. It would therefore be useful if it could be shown that the changes in the c.t. product with temperature required for a positive result with the sachet were in step with the corresponding changes in c.t. product required for an effective fumigation.

It is evident that the basic idea of a sachet control can be applied in many ways. Various plastic materials e.g. polythene, P.V.C., nylon and others can be employed for the sachet envelopes, all of which have somewhat different diffusion characteristics. Many absorbents are known for the various fumigant gases and the gas absorption can be varied widely by alteration of the strength of the absorbent. The amount of gas absorbed can also be adjusted by alteration of dimensions of the sachet. Various internal or external indicators or reagents are also available. So many variables are involved, and so many variations are possible that an arbitrary choice of materials and empirical methods of manufacture of the sachets are inevitable. We have, therefore, limited this paper to reporting work on two suitable devices involving two fumigant gases (ethylene oxide and methyl bromide) which exemplify the use of the sachet with an internal indicator and the sachet + external reagent respectively. The chemical reactions employed are based on standard analytical methods for these fumigants.[4,5]

Experimental

Materials

Sachets

These were made from 1 in. layflat polythene tubing of 0.002 in. thickness. Pieces 2¼ in. long were cut from the tubing and one of the cut edges sealed by welding in a gas flame. Five ml. quantities of the respective absorbent solutions were filled into the envelopes so produced. The open end was sealed, again by heat welding in the flame, so that the finished sachet had an overall length of about 2 in.

The required strength of all absorbent solutions was obtained by a series of empirical tests. Any filled sachets which were outside the limit 2 in. + 0.05 in. long, or which differed in weight from the mean weight by more than + 1%, were discarded.

An external reagent was used for methyl bromide sachets to indicate, after exposure of the sachet, whether Ag ions or Br ions (under exposure or over exposure respectively) were present.

Ethylene Oxide Absorbent Indicator Solution

	c.t. product 250 *mg. hr./litre for use at* 15° C.	25° C.
Hydrochloric Acid, N/10 Solution	0.38 ml.	0.66 ml.
Bromophenol Blue, 0.04% Solution ..	0.25 ml.	0.25 ml.
Magnesium Chloride Saturated Aqueous Solution to	5 ml.	to 5 ml.

Methyl Bromide Absorbent Solution

	c.t. product 200 *mg. hr./litre for use at* 15° C.	25° C.
Monoethanolamine ..	2.25 ml.	2.25 ml.
Silver Nitrate, N/10 Solution	0.145 ml.	0.282 ml.
Distilled Water .. to	5 ml.	5 ml.

	c.t. product 1000 *mg. hr./litre for use at* 15° C.	25° C.
Monoethanolamine ..	2.25 ml.	2.25 ml.
Silver Nitrate, N/2 Solution	0.175 ml.	0.34 ml.
Distilled Water .. to	5 ml.	5 ml.

Methyl Bromide Reagent

Nitric Acid B.P.	2.5 ml.
Silver Nitrate, N/10 Solution	0.20 ml.
Ammonium Thiocyanate, N/10 Solution	0.20 ml.
Ferric Ammonium Sulphate	0.05 gm.
Distilled Water to	10 ml.

End Points

Ethylene oxide sachets are a clear yellow colour when prepared. After exposure to ethylene oxide they change to a strong violet colour.

Methyl bromide sachets are colourless when prepared, but show some darkening after a few days storage. No visible change occurs on exposure of the sachet to methyl bromide. The reagent contains a small quantity of precipitated silver thiocyanate. On clipping off a corner of the exposed sachet and transferring some or all of the

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contents to the reagent we obtain further white to pale yellow precipitation, i.e. virtually no change (excess Ag^+), or a reddish brown coloration rapidly develops (excess Br^-).

Methods

In order to test the sachets, predetermined concentrations of the fumigants were produced in steel fumigation chambers of either 1,700 or 3,000 litres capacity. The temperature was controlled at either 15° or 25°C. Fumigant concentrations were measured at the beginning and end of a test either by chemical analysis or by the use of a thermal conductivity meter.

The ethylene oxide sachets were observed through an inspection window in the fumigation chamber during the tests. Near the end point a change of colour was first noticeable at the edges of a sachet. At this stage it was removed from the chamber and its contents mixed by squeezing the sachet gently with the fingers. This caused a change to either an homogeneous yellow (unchanged) or violet (changed) or if it was just changing a greenish blue was obtained. The colour was then observed and if the change to a greenish blue or violet had not taken place the sachet was returned to the chamber.

Methyl bromide sachets do not change colour during fumigation, and since at each stage the sachet is tested to destruction it is not possible to obtain such close control in testing as with the ethylene oxide sachets. This difficulty could be overcome in practice by using greater numbers of the sachets so that more can be tested at each stage, although it was not possible to use large numbers in these early tests.

In early experiments with both fumigants, sachets were withdrawn from the chamber at intervals and their contents titrated to determine the amount of fumigant which had been absorbed. This procedure was useful as a check on the accuracy and sensitivity of the method, and as a means of establishing the amount of absorbent to be used so as to obtain the indicator colour change at the desired c.t. product. Nevertheless, it was felt that the best ultimate method of testing was that which would be employed when using the sachets in routine fumigation work i.e. when several sachets would be exposed in a single fumigation and the result recorded as the number giving a positive reaction at given c.t. products. This was the procedure used to obtain the results given in Table II. Further tests were carried out in the presence of carbon dioxide. These showed the sachets to be unaffected by the presence of carbon dioxide in the fumigation chamber.

It is inconvenient to have to use a range of sachets to cover a range of temperatures for one c.t. product. Also, as previously mentioned the higher the temperature, the lower the c.t. level required for insect control. Tests were therefore made at 25°C. to investigate the level at which methyl bromide sachets designed for a c.t. of 200 mg. hr./litre at 15°C. would give a positive reaction. The average of a number of results was a c.t. of 120 mg. hr./litre.

As the 15° sachets give a positive reaction for a c.t. of 200 at 15° and for a c.t. of 120 at 25°C. and, as shown in Table I for insect control the c.t. products required are 180 and 100 at these temperatures, it would appear that one sachet could probably be used at all normal fumigation temperatures. The slightly higher level of c.t. required for the sachets in these tests might be considered as a reasonable safety margin for commercial fumigation work. However, more work is required on this point.

Although only a limited number of sachets have been tested the results show that the predicted c.t. for a positive result has been obtained with only small variations in any one test batch. These small variations could be due to differences within the stated manufacturing tolerances and/or differences in position of the test sachets in the chamber. This latter factor has been found to be of little importance when using the sachets described above and little variation has been found in the results obtained with sachets lying on a solid or perforated surface or hanging freely suspended from a paper clip at one end of the sachet. With earlier experimental sachets containing only 2 ml. reagent in the same sized envelopes, hanging sachets gave different results probably due to the bulk of the reagent draining down and thus being in contact with only a limited portion of the polythene envelope. This

effect has been largely eliminated by increasing the volume of the sachet contents to 5 ml.

The sensitivity of the sachets to small changes in c.t. product has been demonstrated most easily with the ethylene oxide sachets. With these, an increase in c.t. of the order of 5 mg. hr./litre was found to change the colour of the indicator from yellow through green to violet. It is evident from Table II that the sensitivity of the methyl bromide sachet is of the same order. It is obvious therefore that the sensitivity of the device is more than adequate and the increase in c.t. product required to produce the change from negative to positive in the

TABLE II
Fumigation Tests with Sachets

Type of Sachet	Concentration of fumigant (mg./litre)	No. of sachets in test	c.t. product mg. hr./litre	No. of sachets showing	
				Pos.	*Neg.*
Ethylene oxide (c.t. 250 at 15°C.)	55	10	230	0	10
			250	6	4
			260	10	0
„	13.1	8	250	0	8
			255	1	7
			260	5	3
			270	8	0
Ethylene oxide (c.t. 250 at 25°C.)	53	7	220	0	7
			240	7	0
„	9.9	8	245	0	8
			250	4	4
			255	8	0
Methyl bromide (c.t. 200 at 15°C.)	62	6	190	0	1
			200	2	2
			210	1	0
„	8.3	10	195	1	2
			200	6	1
Methyl bromide (c.t. 200 at 25°C.)	54	8	190	8	0
„	11.7	10	190	0	2
			195	0	2
			200	0	2
			210	2	2
Methyl bromide (c.t. 1000 at 15°C.)	62	8	980	1	1
			990	1	2
			1000	3	0
Methyl bromide (c.t. 1000 at 25°C.)	54	13	990	0	3
			1010	2	2
			1020	1	1
			1030	3	1

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sachet is smaller than the slight normal variations between sachets.

Discussion

The sachet devices described record the c.t. product of a fumigation within limits of error less than + 10%, at the place where they are exposed. They thus give a measurement of the attainment or otherwise of lethal conditions in a fumigant sufficiently accurate for practical purposes.

Where there is a change of colour e.g. in ethylene oxide sachets, they can be inspected during fumigation to determine when all insects are dead at that point, or whether there is need to add more gas or lengthen the exposure time. With methyl bromide sachets, which are destroyed in determining the end point, the same purpose can be achieved by replication of sachets at various points and successive withdrawals and testing at appropriate intervals.

If assurance is required that the treatment has exceeded a certain level (lethal to insects) but did not exceed a somewhat higher level (damage to germination properties or other deleterious change) then sachets at two appropriate c.t. product levels can easily be produced to give this assurance.

The sachets described were designed for use by fumigant operators in the field, to give a direct answer to the question " Was the fumigation satisfactory? " They can however be used quantitatively to indicate approximately the average c.t. product achieved at any point in a fumigation. This can be done on the spot if laboratory facilities for simple titrations are available, alternatively the sachets may be transmitted to the laboratory for later examination.

For the ethylene oxide sachet, if under exposed i.e. the violet colour has not been obtained, the contents of the sachet can be transferred to a small beaker or titration flask and titrated to the end point with N/100 alkali. Equally if the sachet has changed colour, then it can be titrated back to the end point with N/100 acid. Since the sachet originally contains 3.8 ml. N/100 acid (c.t. product 250 mg. hr./litre at 15°C.) then by calculation the required addition to or subtraction from the designed level of c.t. product 250 mg. hr./litre is found, and hence the approximate c.t. product achieved at that point in the fumigation.

The methyl bromide sachets can also be titrated to the end point. The contents of the envelope are mixed with 10 mls. of the specified reagent in order to determine if the end point has been reached. Thereafter the mixture so produced can be titrated forward to the end point with N/100 bromide solution for an under exposed sachet, or back to the end point with N/100 silver nitrate solution for the over exposed sachet. Since the sachet originally contains the equivalent of 1.45 mls. N/100 silver nitrate (c.t. product 200 mg. hr./litre at 15°C.) again it is a simple matter to calculate the approximate c.t. product achieved at the relevant point in the fumigation.

Slight errors are involved in these titration procedures, and it is important to ensure that the whole contents of the sachet are used. However the error in the c.t. product so obtained is small, certainly less than + 10% felt to be tolerable for practical fumigations.

Patent applications in respect of these devices have been filed and the sachets are now available commercially.

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REFERENCES

[1] Heseltine, H. K., Pearson, J. D., and Wainman, H. E. *Chem. and Ind.*, 1958, 1287-88.
[2] Royce, A. and Bowler, C. *J. Pharm. Pharmacol.*, 1959, **11**, 294T.
[3] Pest Infestation Research Bulletin No. 1 (Revised Edition) H.M.S.O. 1959.
[4] El. Khishen, S. A. *J. Sci. Food Agric.*, 1950, **1**, 71.
[5] Lewis, *J. Soc. Chem. Ind.*, 1945, **64**, 57.

Toxic Chemicals in Agriculture

A.B.M.A.C.'s Reply to Unqualified Criticism

OVER the past few months there has been increasing public and press comment, mainly unfavourable, on the use of chemicals in the production of agricultural crops in this country. Little or no prominence has been given to the chemical manufacturers' point of view, and I feel in order that this matter may be seen in its true perspective, it is necessary that a statement should be made on behalf of the agricultural chemical manufacturers.

Press references have alleged that crop protection chemicals have " Upset the balance of nature;" " Decimated the bee population;" " Denuded the countryside of plant and animal life." On several occasions press references have been misinformed and, indeed, incorrect. One responsible professional journal has even gone so far as to link radio-activity from atom bombs with agricultural chemicals on farm crops.

It would perhaps be appropriate to explain the action taken by the manufacturers of crop protection chemicals before a new product is marketed, lest the mistaken impression gains impetus that there is widespread indiscriminate use of dangerous chemicals on the land. The appalling ignorance by many in official places is, perhaps, an indictment of the industry in not constantly reminding the public of its work.

No crop protection chemical is marketed in the U.K. by members of my Association until the risks associated with its use have been most carefully examined by the Ministry's expert committee. This committee was set up specifically to examine the possible risks of agricultural chemicals whether to the public, the farmer, or to wild life. Where safety precautions are thought to be necessary with any product, they are laid down by this expert committee and voluntarily accepted by the industry. As far as I am aware, no other products used in the U.K. are subjected to such rigid arrangements, yet these were not only entered into voluntarily, but were, in fact, suggested by the industry.

This is the chemical age; Sputniks, atomic power stations, man-made fibres and plastics—to name only a few developments in recent years — could not have happened but for the chemist and chemical engineer. Similarly, it would not be possible to feed the millions of people of this world without chemical aids. Crop protection chemicals and other agricultural chemicals are here to stay. The alternative must be starvation for millions now living on this planet. Furthermore, it will not be the people of the backward countries who will suffer most, but those living in such densely populated areas as Western Europe, where the standard of living demands the maximum yield from every acre under cultivation. The civilised world must learn to live with agricultural chemicals or revert to a food rationing system far more rigid than was ever experienced during the war. The ration would be in the form of weevil infested flour, scabby and maggoty fruit, and disease and pest-ridden vegetables.

It is only just over 50 years ago that the man with the red flag preceded the motorcar; we are at that stage now with crop protection chemicals. These chemicals are the tools of the progressive farmer, and civilisation must learn to live with them and adapt them to its needs; not to use them would be to spell out hunger and misery for millions. If insects were allowed to develop unchecked they could master the world, for they transmit dangerous diseases. The housefly is blamed for polio; the mosquito is responsible for carrying malaria, and other pests transmit diseases such as sleeping-sickness and typhus. Apart from these, pests such as wireworm, aphis, caterpillar and Colorado beetle devour our crops, and fungus diseases such as potato blight can kill crops overnight.

Responsible research workers in this country have estimated that the loss of crops to our agricultural economy caused by weeds, pests and disease, is of the order of £140 million of produce per annum. In other words, the loss could be as much as 10% of the total value of agricultural produce in the U.K. This loss is one that the use of chemicals can substantially reduce. This does not mean, however, that such products will be indiscriminately used, or that the expert committee will be any less vigilant.

Among the objects of the Association, of which I have the honour to be Chairman, one principal aim is to encourage the exchange of technical information within the industry, with research stations, with Government bodies, and with other authorities. This, and other safeguards indicate, I feel, the sense of responsibility that manufacturers have, and the close co-operation which exists at the respective levels between manufacturers and the Ministry of Agriculture, Fisheries and Food.

A NEW METHOD OF SEED TREATMENT

By C. P. HAMPSON, B.Sc., M.I.Biol., K. HOLBROOK, B.Sc., and W. B. LUCAS, B.Sc., A.M.I. Chem. E.
(*British Schering Limited*).

THE TREATMENT OF SEEDS for the control of certain seed-borne disease organisms and as a preventive against soil insect pest attack is one of the most successful and economic applications of chemical crop protection techniques in use today. This practice is not new, however, for the Romans used to dress seed with ashes and other concoctions to preserve the crop from disease and in England as early as the 17th century, seed grain was sprinkled with sea water and dusted with lime, for it was discovered that grain salvaged from a shipwreck produced an amazingly healthy crop.

The first scientific method of seed disinfection, however, was discovered in France in 1807 by Benedict Prevost who developed the use of copper sulphate solutions for the control of smut diseases of cereals. The great disadvantage of this so called " wet dressing " was the necessity of having to artificially dry the seeds after treatment. To overcome this difficulty more effective fungicides for use as dry treatments were discovered of which mercury was found to be the most effective. The first powder dressing of this type was introduced by the I.G. Farbenindustrie in Germany, but similar lines of research by the I.C.I. and other companies led to the introduction of a number of different formulations of this type e.g. Abavit B was introduced into this country in 1926.

Nowadays these dry organo-mercurial seed dressings are very extensively used and nearly all the cereal seed sown in this country today is treated with one or other of the proprietary dry seed dressings for this purpose. Successful as these powder dressings have been they do have certain disadvantages of which flying dust is perhaps the greatest. In an attempt to eliminate this to a certain extent, oily substances are added to these formulations, but since the principle of dry seed dressing rests in the ability of the powder to fly around everywhere in order to cover each seed, it is not possible to eliminate this dust to more than a certain extent. To overcome this problem attention returned to " short wet " treatments in which smaller quantities of liquids are involved. However, still comparatively large volumes of liquids were employed and the moisture content of the treated seed was increased to such an extent that the seed had to be sown within a few days after treatment to prevent spontaneous heating of the stored grain.

A most important development in seed treatment was made, however, just before the last war by Professor Zade of Sweden who showed that it was possible to treat seed with a liquid disinfectant with the same minute quantities of disinfectant by weight of seed as when using powder seed dressings and that the seed after such treatment *neither became perceptibly moist nor sticky*. By this method the disadvantage of dust involved in the use of powder seed dressings was removed and it is interesting to note that in a report " on the use of seed treatment products for sale in Canada 1958 " of the twenty-seven organo-mercurial seed treatments mentioned eight were liquids, fifteen were wettable powders for use as liquids and only four were powders for use as dry seed dressings. A further indication of this trend towards liquid seed treatments is given by Professor L. D. Leach of the University of California who writes that " dusting of seed has been almost entirely replaced by some type of ' quick wet ' application in most of the United States."

Liquid seed dressings, however, present certain problems so far as obtaining uniform distribution of the very small amounts of the liquid disinfectant is concerned. To overcome this problem and to obtain uniform distribution of the liquid seed dressing the Mist-O-Matic method of liquid seed treatment was developed in the United States and it is now being introduced, after extensive trials, by British Schering to seed merchants in the United Kingdom and Ireland.

The Mist-O-Matic method of seed treatment

Hitherto the application of a chemical treatment to seed was basically the same, irrespective of whether the treatment applied was a powder or a liquid dressing i.e. a quantity of the treatment is dropped or dripped on to the appropriate quantity of seed and then an attempt is made to distribute the treatment evenly over the seed by mechanical mixing in a revolving drum. This method of distributing the treatment might work fairly satisfactorily with powder dressings, but when the liquid seed dressings are applied in this simple manner at a rate of one fluid ounce per bu. which is roughly equivalent to one drop of the liquid to 4,000 seeds, it is considerably more difficult to obtain uniform distribution of the treatment. The method, up to date, of tackling this problem of distributing small quantities of chemical over large quantities of seed is to depend upon the use of volatile mercurial compounds. By the use of these compounds, uneven distribution of the liquid is largely overcome by the subsequent vapour action of the volatile mercurial compound used as the seed treatment. This vapour action, however, will be dependant upon certain climatic atmospheric and storage conditions for optimum effect and it will not, of course, operate in the case of the relatively non-volatile insecticidal liquid seed treatment.

For maximum efficiency, therefore, it is important that the initial distribution of the chemical seed treatment should be as even as possible.

Seed treatment should not, therefore, be based on dumping so much powder, or dripping so much liquid on to an appropriate quantity of seed, but on the basis of treating the individual seed. By the Mist-O-Matic method, the small quantities of the liquid dressings are atomised into a very fine, penetrating, spray mist through which the seed to be treated has to pass. This spray mist is retained in the atomising chamber and as the seed passes through this chamber every seed comes into contact with thousands of " mist size " particles which colours the seed a distinctive red.

The Mist-O-Matic Machine

The application of a liquid seed dressing in the form of a mist involves the use of a specially designed machine. This machine (see drawing) is capable of treating seed at a rate of up to nine tons per hour, the actual through-put will, of course, depend upon the rate at which cleaned seed is fed to it. As the grain flows into the machine (see Diagram 1) it alternately fills each one of the two seed pans of the dump hopper (D). When these contain the correct amount of seed, as regulated by the setting of the counterweight (B), the pan tips and the other pan is then filled. This intermittent flow of grain is converted into a uniform flow by means of retarders (A). From the retarders the grain falls over the cone spreader (E) into the atomising chamber (H). The spindle of the seed pan hopper is connected to an arm carrying two stainless steel cups (L). When the seed pan empties it tilts the connecting arm of the liquid feed mechanism and the contents of one of the cups is decanted down the liquid feed line to the atomising disc in the seed treating chamber. The physical properties of the specially formulated liquids and the construction of the feed line in the machine ensures an even flow of liquid to the atomising disc (G). The level of liquids in the metering tanks (M) is maintained by a small pump which draws the liquids from the containers in which these liquids are supplied. Excess liquids return to the containers by means of an over flow. There are two metering tanks, one for the mercurial liquid and the other for the insecticidal liquid. For dual purpose protection against seed borne diseases and wireworm the two liquids are applied simultaneously. When changing from a dual treatment to a straight mercurial treatment, it is only necessary to open a by-pass valve (K) and allow the insecticidal liquid to drain from the metering tank back to its container. In order to treat the seed for wheat bulb fly control larger measuring cups are quickly inserted so

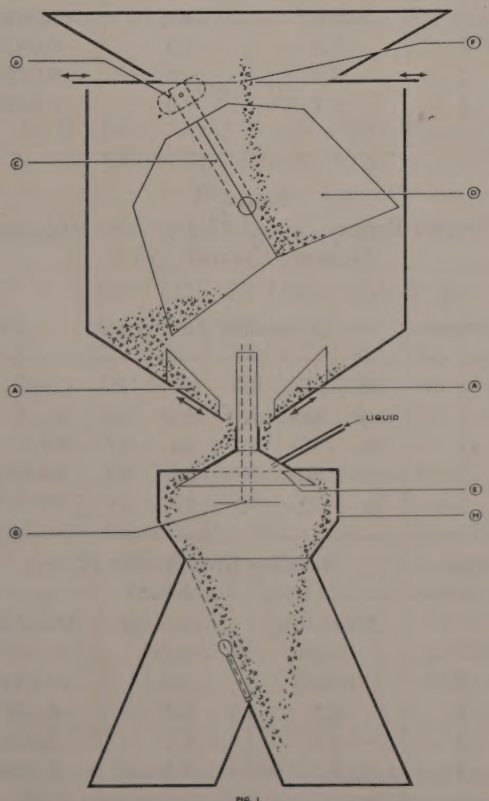
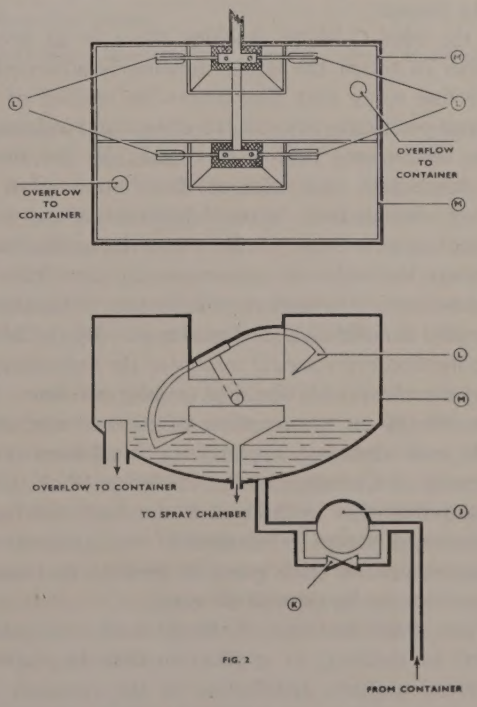


Diagram 1. Illustrating the Mist-O-Matic process.



(A) RETARDERS	(G) ATOMISING DISC
(B) COUNTERWEIGHT	(H) SPRAY CHAMBER
(C) COUNTERWEIGHT ARM	(J) PUMP
(D) DUMP HOPPER	(K) BY-PASS VALVE
(E) SPREADER	(L) MEASURE CUPS
(F) FEED GATE	(M) METERING TANK

that a double dose of the insecticide treatment is given. The pumps and atomising disc are all driven by means of a $\frac{1}{3}$ H.P. single phase electric motor.

Advantages of the Mist-O-Matic method

A serious disadvantage with dry seed dressings is the continual presence everywhere of flying dust which covers all areas and surfaces where powder dressings are used. In addition the poisonous powder fills the atmosphere thus endangering the health of personnel carrying out the dressing. Another disadvantage of dry seed dressings is that they cannot penetrate the minute cracks and crevices in the seed coat and therefore they cannot get at all the deep seated fungus spores which may be lying in these indentations. Furthermore the powder does not adhere to the surface of the seed and it falls off very readily during the handling and transportation of the sacks.

The use of liquid seed treatments does away with the hazard of toxic dust. However certain liquid seed treatments, in order to obtain adequate and more even distribution of the disinfectant, use highly poisonous volatile chemicals, which give off dangerous vapours during the treatment of seed. Poisonous vapours are also given off from the seed which has been treated with these volatile mercurial liquid dressings and this presents a further hazard of dangerous vapours from treated seed kept in storage.

In the Mist-O-Matic machine there is an enclosed chamber in which the liquid dressing is atomised into a very fine spray mist that covers the surface of every seed and penetrates into all the cracks and indentations in the seed coat. This method provides for the first time immediate and efficient distribution of a seed dressing without toxic hazards from dusts and as it is not necessary to use volatile mercurial compounds it minimises the risks of poisonous vapours from such seed dressings. The uniform distribution of the chemical is essential for effective seed treatment. By the Mist-O-Matic method *every seed is treated at the time of application of the chemical in the seed treating machine.* From the results of an examination of various methods of liquid seed dressing application, conducted at the University of Cornell, U.S.A., Professor W. F. Crosier reported that this method gave the best distribution, for when seed treated by this method was examined under the microscope, no seeds could be detected that were not coloured by the liquid seed dressing.

Where other methods of liquid seed treatment are applied by methods of application that do not ensure this initial uniform distribution of the chemical, some seeds will have deposits of liquid higher than is necessary for good control and there is then a risk of " over dressing " phytotoxic effects, while other seeds will have insufficient treatment for effective protection.

Extensive tests have been carried out by the technical department of British Schering Ltd. and these have shown that Mist-O-Matic Liquid Seed Dressings do not impair germination and early growth. The results of some of these tests are shown below.

Treatments

1. Mist-O-Matic Mercury Liquid Seed Dressing (1 fl. oz. per bu.).
2. Mist-O-Matic Mercury + Mist-O-Matic Wireworm Liquid Seed Dressing (1 fl. oz. of each per bushel).
3. Control—untreated.

TABLE I

Capelle Wheat—Stored 62 days after dressing.
Moisture content: 16%

Treatment	*% Seedling Emergence*						*Total*
	8th day	*9th day*	*10th day*	*11th day*	*12th day*	*13th day*	
1	17	46	77	87	93	98	98
2	15	39	63	89	99	100	100
3	15	33	59	83	96	99	99

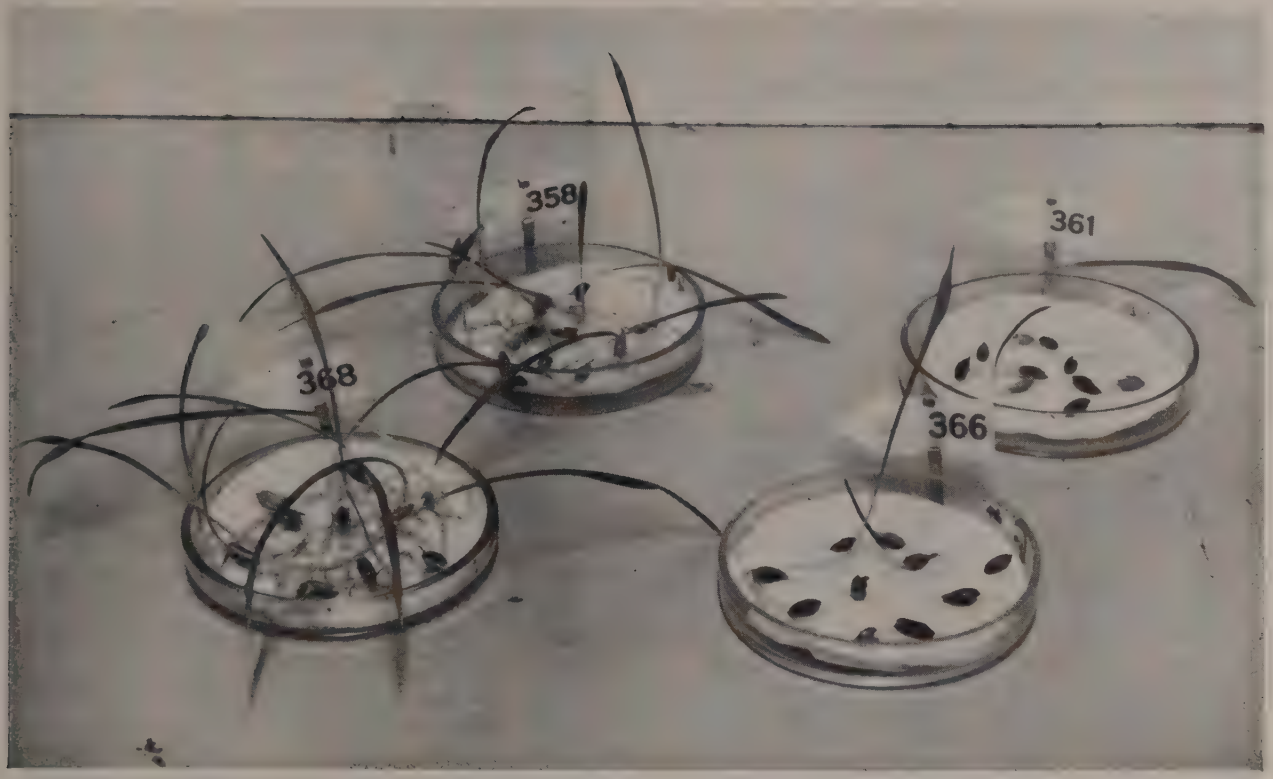
Treatment	*Seedling Growth after 14 days*		
	Mean Leaf Height (cms.)	*Mean Root Length (cms.)*	*Mean Dry Wt. leaf and root (g.)*
1	5.8	9.3	0.0432
2	6.6	9.6	0.0455
3	5.3	9.0	0.0420

TABLE II

Proctor Barley—Stored 42 days after dressing.
Moisture Content: 16%

Treatment	*% Seedling Emergence*						*Total*
	7th day	*8th day*	*9th day*	*10th day*	*11th day*	*12th day*	
1	38	75	92	94	97	99	99
2	52	80	97	99	99	99	99
3	38	72	93	97	97	97	97

Treatment	*Seedling Growth after 12 days*		
	Mean Leaf Height (cms.)	*Mean Leaf Length (cms.)*	*Mean Dry Wt. leaf and root (g.)*
1	8.1	8.2	0.0287
2	8.4	8.7	0.0287
3	7.7	8.8	0.0280



Onward oats infected with Helminthosporium avenae

Healthy seedlings in dishes 368 and 358 grown from seeds treated with Mist-O-Matic Mercury Seed Dressing. Seeds in dishes 361 and 366 not treated.

TABLE III

S.172 Oats—Stored 24 days after dressing.
Moisture Content: 16%

Treatment	*% Seedling Emergence*						*Total*
	7th day	*8th day*	*9th day*	*10th day*	*11th dsy*	*12th day*	
1	25	40	73	77	80	82	82
2	33	47	77	82	88	88	88
3	32	43	71	81	81	81	81

Treatment	*Seedling Growth after 12 days*		
	Mean Leaf Height (cms.)	*Mean Root Length (cms.)*	*Mean Dry Wt. leaf and root (g.)*
1	7.4	10.7	0.0241
2	7.0	9.5	0.0234
3	7.5	9.8	0.0235

Where these liquid mercurial treatments are used in conjunction with insecticidal liquid seed treatments, it is even more essential that the chemical treatments should be uniformly distributed, for where non-volatile insecticidal liquids are used the treatment must be applied evenly to the individual seeds. Because of this it is advisable to use a method that ensures uniform distribution of the liquid seed treatment at the time of application of the chemical rather than a method that relies on vapour or volatile action to redistribute the chemical after it has been applied.

The even distribution of liquid seed treatments in the Mist-O-Matic treater is independent of vapour action. Once treated by this method the seed cannot lose its dressing and the liquid seed treatments will not rub off during handling nor will they be lost as toxic vapours on exposure to the air. Furthermore by the application of the liquid as a fine penetrating spray mist in the treater, it is possible to apply a liquid seed treatment to every seed thereby obtaining effective and efficient seed treatment and protection.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the help given to British Schering by the trade, official organisations and farmers in connection with the development of the Mist-O-Matic process.

Preliminary Tests of an Insecticidal Lacquer Containing Malathion

By C. E. DYTE (*Pest Infestation Laboratory, Agricultural Research Council*).

Introduction

INSECTICIDAL LACQUERS have been widely used to control crawling insects in hospitals, kitchens and ships, and have been used to a lesser extent in libraries, maltings, and laboratory-animal houses. The insecticide most commonly incorporated in these lacquers has been dieldrin, but other chlorinated hydrocarbons, such as endrin and DDT, have also been used. Such compounds normally form crystals on the surface of the dried lacquer film, and the presence of crystals has been considered important for adequate biological activity. However, lacquers containing these chlorinated hydro-carbons slowly emit an insecticidal vapour, and are often effective although no surface crystals are formed. It seemed possible, therefore, that lacquers containing non-crystalline insecticides might be effective. Preliminary tests are now described in which a lacquer containing malathion has given encouraging results against several species of insects commonly occurring as pests of stored foodstuffs.

Formulation

The lacquer used was of the acid-hardening type and was prepared in the laboratory. The formulation was similar to that given in Example 3 of British Patent 709,721, except that the accelerator was A.C. 64 and the insecticide added was technical (95%) malathion. Accelerator A.C. 64, and the resins used in this formulation, are manufactured by British Industrial Plastics Ltd.

Normally the technical malathion was added at the rate of 10% by weight of the lacquer solids, and the lacquer applied by pipette to the upper surface of small, planed softwood blocks at the rate of 177 mg. malathion per sq. ft. During application the pipette was moved over the surface of the block, and the lacquer spread as evenly as possible with a small artist's paint brush. Lower concentrations of malathion were used in one experiment; the lacquers were, however, applied as thicker films so as to maintain the dosage rate of 177 mg. malathion per sq. ft.

Toxicity to Insects

Seven species of beetles, all of which are important pests of stored foodstuffs, were exposed until dead on the wooden blocks treated with 10% malathion lacquer. Three batches of 50 individuals of each species were confined by glass rings 6.25 cm. in diameter and 2.0 cm. in height. Perspex lids containing an area of gauze for ventilation covered all the rings except those containing the three species of flour beetles; these three species are unable to fly or to climb glass. The insects were without food and the blocks were maintained at 25°C. and 70% R.H.

The mortality rates are shown in Table I. They are of the same order as those commonly experienced with lacquers containing chlorinated hydro-carbon insecticides, and the rapid death of the Saw-toothed grain beetles and the relatively slow death of the Australian Spider beetles are in keeping with the data given by Parkin[1] on the susceptibility of various beetles to malathion applied as dusts and wettable powders.

The larva of the Khapra beetle, *Trogoderma granarium* Everts, is a serious pest of stored foodstuffs, and is not readily controlled by insecticides. Dieldrin is known to be one of the more effective insecticides against this insect, and Goodliffe[2] has recommended the use of dieldrin lacquer for the control of Khapra beetles in maltings. A comparison has been made, therefore, of the toxicity to larval Khapra beetles of lacquers containing 10% dieldrin or 10% malathion. Both were relatively

TABLE I

Mortality rates of adult beetles continuously exposed to wooden blocks treated with 10% malathion lacquer.

Insect		*Time in hours for mortalities:* 50%	95%	*Control Death at time for* 95% *mortality*
Saw-toothed Grain beetle	*Oryzaephilus surinamensis* (L.)	17	41	5%
Flat Grain beetle	*Cryptolestes turcicus* Grouv.	33	50	nil
Broad Horned Flour beetle	*Gnathocerus cornutus* (F.)	39	54	nil
Grain weevil	*Calandra granaria* (L.)	42	84	2%
Rust-red Flour beetle	*Tribolium castaneum* (Hbst.)	46	92	nil
Confused Flour beetle	*Tribolium confusum* Duv.	64	108	nil
Australian Spider beetle	*Ptinus tectus* Boield.	224	362	4%

slow in action, but the malathion lacquer was more effective and achieved 50% mortality in 450 hours compared with 600 hours taken by the dieldrin lacquer.

Malathion lacquer has not yet been tested against other species, but it is likely to be suitable for the control of crawling insect pests susceptible to this insecticide in other formulations. In particular it may be of value against cockroaches in places where the use of dieldrin would be inappropriate, or where strains occur which are resistant to chlorinated hydrocarbon insecticides. Clarke and Cochran[3] have shown that strains of the German cockroach, *Blattella germanica* (L.), which are resistant to DDT, or chlordane and dieldrin, are susceptible to malathion.

Effective Life

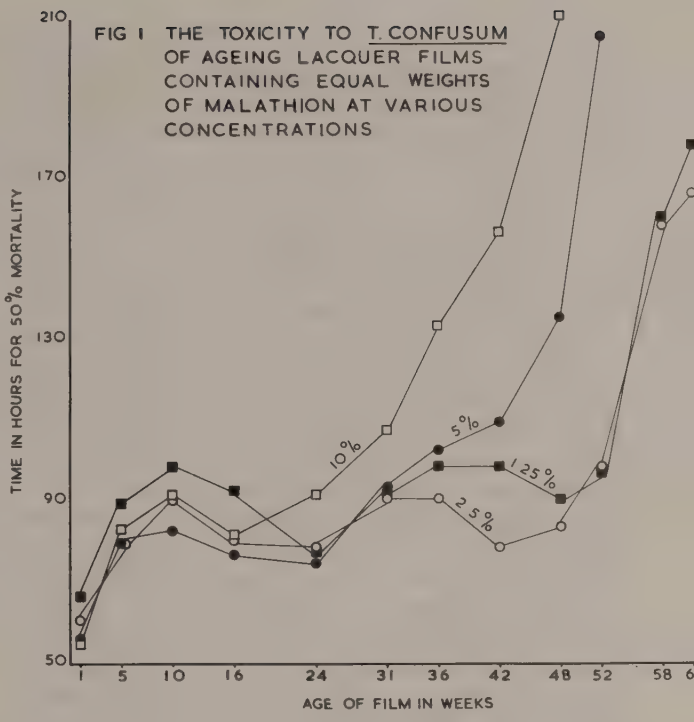
The effective life of a film of malathion lacquer will depend at least in part upon the rate at which the insecticide is lost as vapour from the surface. This evaporation rate will probably be directly related to the concentration of malathion in the lacquer, so that when the same quantity of malathion is applied to a given area in different volumes of lacquer, the less concentrated treatments are likely to emit insecticidal vapour more slowly, and therefore, within limits, remain effective against insects for longer periods. To test the effect of concentration upon effective life, lacquers containing 10, 5, 2.5 and 1.25% malathion were prepared, and these were applied to wooden blocks so as to give equal dosages of malathion per unit area. By this method the same quantity of malathion was applied in one, two, four and eight volumes of base lacquer.

The treated blocks were stored at 25°C. and 70% R.H., and their toxicity to adult Confused Flour beetles, *Tribolium confusum*, 4-5 weeks old, was determined at intervals during a period of 61 weeks. The exposure times needed for 50% mortality on the different blocks at each test are shown in fig. 1. With films 5 weeks old a 50% kill was obtained on all blocks with exposures between 75 and 100 hours. The treatments with eight volumes of 1.25% and four volumes of 2.5% malathion lacquer retained this level of effectiveness for a year, but the other two treatments became slower in action after 31 and 24 weeks respectively.

It is apparent, however, that a malathion lacquer can be produced with an effective life of at least a year under laboratory conditions of storage and test, but it may be difficult to apply very thick films to vertical surfaces in practice.

Toxic Hazard

Published data indicate that malathion is a safer toxicant than those at present used in insecticidal lacquers. It has acute and chronic mammalian toxicities which are lower than those of DDT or lindane, and much lower than those of dieldrin or endrin.[1]



It has previously been shown[4] that flour is readily contaminated by the insecticidal vapours emitted by dieldrin and endrin lacquers. Using similar methods it has now been found that malathion lacquers also emit insecticidal vapour which is absorbed by flour. However, malathion is unstable to heat, and preliminary tests have indicated that flour contaminated by this insecticide loses its toxicity to adult Confused Flour beetles if it is heated for 30 min. at 100°C. This is not the case with flour similarly contaminated by a dieldrin lacquer. Malathion lacquer may therefore prove suitable for use in close proximity to many foodstuffs where the use of other lacquers could constitute a toxic hazard. Further work on this and other aspects is in progress.

ACKNOWLEDGEMENTS

The writer is grateful for advice from Mr. A. A. Green, and for technical assistance from Mr. P. S. Tyler and Mr. D. R. Wilkin.

REFERENCES

[1] Parkin, E. A., A provisional Assessment of Malathion for Stored-Product Insect Control. *J. Sci. Fd Agric.*, 1958, **9**, 370.

[2] Goodliffe, E. R., Rat destruction in breweries with particular reference to maltings. *Brew. Guild J.*, 1955, **44**, 460.

[3] Clarke, T. H., and Cochran, D. G., Cross resistance in insecticide resistant strains of the German Cockroach, *Blattella germanica* (L.). *Bull. World Hlth Org.*, 1959, **20**, 823.

[4] Dyte, C. E., Use of Insecticidal Lacquers in Flour Mills. *Milling*, 1958, **131**, 742.

DRIFT*

by Dr. E. C. S. LITTLE, M.Sc., (Oxford)

IN AGRICULTURAL AVIATION " drift " is referred to by farmers, aircraft operators and even by scientists with a certain thoughtful caution because they feel that here lies the chief disadvantage of the aerial application of chemicals. The danger of drift is often stated as being the reason why certain types of work in certain districts are unsuitable for aerial farming. The danger is seldom defined or the limits of the hazards involved made clear. This is, probably, because they are not known.

Like anything else which tends to be a bogey the problem of drift can be made to seem less sinister and frightening if it is brought out into the open and thoroughly inspected. Though a considerable amount of technical research work has been done a lot more time, money and imaginative effort is needed by all concerned with agricultural aviation if enough is to be known about the real limitations which drift imposes on chemical applications from the air.

The mathematical complications are considerable when particles of differing density are released into the atmosphere and come under the influence of gravity; with a complex combination of speeds and direction of delivery imparted at the discharge orifice, modified by the aircraft's movement and the turbulence it creates, and finally controlled by the velocity of the wind and its eddies. In the case of sprays which are evaporating rapidly the droplets are constantly losing weight at a rate varying with the temperature and the humidity—factors which themselves tend to alter with altitude.

Thus to be able to predict with confidence and accuracy the future path of chemicals released from an aircraft is a task of the utmost difficulty under any conditions—unless the objects released are things like fence posts, or bales of hay released from zero feet from a hovering helicopter! Contrasted with these examples, where the mass of the released object is so large in relation to its volume that gravity is the only force whose action is of importance, there are at the other extreme, the particles of dust in a fertilizer or the minute crystals left after a spray has evaporated, on which gravity is virtually without effect and which remain dependent in the currents of air until chance brings them to earth.

More research needed

It is the task of scientists to work out how the problems of aerial application of chemicals can be scientifically measured and controlled and the consequences of operations predicted with reasonable accuracy.

How formidable are the problems involved is clear from the work already published by those engineers, mathematicians, chemists and physicists who have interested themselves in this field. Necessarily much of this study has been done on ground applications. To simulate, in the laboratory, the complicated sequence of events which follow when a pilot on a normal aerial farming job turns on a spray or opens a hopper needs extremely expensive equipment. To measure what happens in the field itself needs elaborate planning, numerous staff, and the time and money available to repeat the experiments sufficiently to absorb all the variables. It is not really surprising therefore that nothing like enough work has been done or has even been planned in spite of the growing importance of aerial farming.

After the workers in the physical sciences have obtained some of the necessary answers biologists have to take over to ensure that what has been found out is made use of in the best way for increased agricultural output. In this vital biological aspect even less work is being done because of the high cost of any experiments connected with aircraft and the inconveniently large plots and other administrative difficulties which are involved.

Some agricultural advisory officers therefore understandably tend to play safe and condemn aerial operations as too risky because of " drift " or, on the other hand, some commercial operators may go into agricultural aviation blindly, learning as they go, and taking the hazards as they find them. Both attitudes are wrong; but one tends to feel sympathy with those enterprising enough to take a chance. Motor cars did not improve much while they had to follow men carrying red flags, and the use of aircraft will not reach its full immense importance for agricultural development in the world until it is boldly exploited with a massive research programme supported by all the sciences involved.

The vital knowledge that is wanted is about the problem of drift and all its implications. We need to know how the chemicals we want can be put on the right target in the right quantities and in the most useful physical form. We must know how losses can be kept to a minimum, what happens to the losses and whether thay are hazardous and if so under what conditions. The influence of aircraft type, equipment, chemicals, and their formulations have to be related to climate, season, the target and neighbouring crops and the whole linked to economics or politics or both. Such a tremendous programme of work needs the justification of a commensurate return. This would come from the full use of aircraft as a vital aid to food production on vast undeveloped tracts of

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the earth and also for increasing yields from areas already being worked. That more food is necessary to match the explosively expanding world population is recognised by everyone but the importance of aircraft for this purpose is either not understood or discounted by many on the grounds of cost and of hazards of which " drift " is the most important. This article is about drift, and having skirted round the subject, it is time to bring it out into the open and look at it more closely.

Useful Drift

Some agricultural operators welcome drift, they are even dependent on it. The best example is the type of fertilizer distributor designed to operate on ridges in hilly country on windy days. The principle is to blow the fertilizer into the air in the optimistic hope that it will thereby be spread evenly down the slope. These devices have survived because the cloud of fine particles rolling down the wind give an impression of wide and excellent coverage masking the uneven winnowing effect which deposits the bulk of the heavy particles close to the machine.

The deliberate fogging of insecticides to aid airborne dispersion into forests, into orchards, among buildings, and indoors and amongst stacks of goods in factories, are examples of the use of drift and of the natural movement in air to reach parts of the target which would otherwise be inaccessible to direct application. Such targets are specialised and limited. They imply either an enclosed or partly enclosed area which tends to trap the airborne particles or a target so large that losses from the margins are small in comparison with the volume released over the area—and even in such conditions fairly still air is needed to keep the bulk of the chemical where it is wanted. In all these operations success tends to depend on release of a great excess of chemical so that the most remote areas receive an adequate concentration in spite of the heavy losses off the target which are inevitable. Such methods can therefore be wasteful and unreliable and are justified only when thay have practical advantages of cheapness and speed.



Bell helicopter fogging and making use of drift.

When slightly larger particles are released, particles which are still under the control of gravity and thus can only travel a short way, drift can be useful to help even coverage; for example when operating over complex hilly country without markers and when accurate pattern flying is difficult. Yet it is under these conditions that any reliance on the wind as an aid can be dangerously misleading. Among hills wind is notoriously inconsistent and sudden changes may accentuate errors rather than conceal them. With heavy aircraft using pelleted fertilizers and flying high above the target judicious cross wind flying can widen the swath and even up application but a great deal more is needed to be learnt about all the aspects of such techniques. Some useful work in New Zealand has been done on both the physical and biological aspects of this problem because of their vital interests in the best utilization of the 500,000 tons of phosphate applied annually from the air.

Fertilizer applicators sometimes claim that completely even application is not essential because grazing stock subsequently spread the fertility evenly; but there is little scientific evidence to prove this one way or the other. Pesticide applicators have to face up to errors because any failure will show up clearly if less than the minimum critical dose is applied. Where the target can tolerate a wide range of concentration, spraying across wind is again sometimes helpful but should not be depended on if complete control of the pest being treated is essential.

Drift hazards

A farmer is often seriously worried when he sees a cloud of fertilizer drifting down wind from an aircraft into his neighbour's land. If more was known about the density of such clouds and their relationship to the total amount of material released it would be a great help to fertilizer manufacturers and aircraft operators. It would be very useful to have some simple method of sampling a product before application so that, by relating the particle size data obtained to wind speed and altitude,



Hiller helicopter spraying gorse in New Zealand. Large droplets are being used and drift is negligible in spite of vortices being formed.

the distance that various fractions would travel under the working conditions chosen could be estimated. In many cases it would probably be possible to show that the loss of fine particles represented an insignificant fraction of the total applied and would therefore be nothing to worry about.

The aspect of drift which causes the most concern is the application of weedkillers from the air. Weedkillers can be poisonous to animals as well as plants (e.g. the nitrophenols and the arsenicals) or they can be of the " hormone " type which are not poisonous to animals but which in very small quantities can cause distortions or death to plants.

It is this idea of almost impalpable and invisible traces of these chemicals travelling long distances through the air and eventually landing on valuable crops with deadly effect which has caught the popular imagination. Sensational stories such as 2,4-D travelling 30 miles or more to ravage cotton crops are remembered and lose nothing in the telling. A climate of opinion has thus been built up that aerial operators who use such sprays as part of their business could be considered to be almost criminally unscrupulous in their persuit of business. Protective legislation is demanded with restrictions, licenses and safeguards.

It is to allay such fears, or to put them on a valid basis if justified, that more knowledge is urgently needed. Because of the difficulties described earlier little is known about how serious the risks really are, or how often damage has been caused, or precisely to what extent. This, of course, excludes those cases where pilots have in error actually sprayed the wrong target. Nor should it include leaks from defective equipment or emergency dumpings. Accidents of this type are inevitable in every new enterprise and any costs or losses are part of the normal development expenses. It does not usually take long for technological skill to improve equipment to the degree necessary to make such episodes rare.

The crucial answers which the aerial spraying of dangerous chemicals demand are:

1. Can the job be done from the air as well and as cheaply as from the ground.
2. What are the most suitable chemicals to use, in what necessary minimum amount, and with how much diluent (if any)?
3. In what form must the chemicals be put on to ensure that a sufficient proportion to be effective lands on the target under various conditions?
4. How far and in what amounts will the quantity which misses the target be likely to drift? How, if at all, will it change while drifting?
5. What effect will these chemicals have, in a range of doses, if they drift onto other crops?
6. How serious are the risks of drift, how often are they likely to occur and to what extent can they be accepted and provided against?

As an illustration we could take a straightforward weedkilling job—say a square field of wheat or a pasture —of 10 acres infested with weeds which can be killed by about 1 lb. (500 grams) of the hormone weedkiller 2,4-D or MCP. Application is to be in water at 5 galls. per acre. The total of 50 galls. needed can be carried by the aircraft in one load. Markers are available. The pilot is skilled. The aircraft will operate at 70 m.p.h. at 10 ft. above the ground using a conventional boom with $\frac{1}{8}$ in. orifice jets at 30 lbs. pressure. The wind is steady at 10 m.p.h., temperature 20°C., humidity 50%.

With this data, is enough known to answer satisfactorily the following questions?

How much of the 50 galls. of water and 5 lbs. of weedkiller will land on the target and will this deal with the weed?

What amounts of the weedkiller per acre will land downwind from the target at, say, 50 yds., 250 yds., and 500 yds.?

What in terms of loss of yield and quality will these amounts have on the following crops growing in the vicinity, say, tomatoes, lettuce, sugarbeet, potatoes or tulips, assuming that they are all young and vigorously growing? If the tulips are flowering how would these answers be affected?

How would these answers be varied if the aircraft operated at 30 m.p.h. with fewer jets of $\frac{1}{4}$ in. diameter at 20 lbs. pressure and 5 ft. above the target?

Would the variations obtained make sufficient difference to be of importance agriculturally, as regards killing the weeds and as regards drift effects?

My opinion is that if this relatively simple problem were put to a variety of interested research workers there would be few teams who could answer all the points with confidence and any answers given would probably vary widely.

The weedkilling experts should be able to answer the

section dealing with the target itself, or most of it, because weedkilling recommendations usually include a fair measure of latitude. It is the drift questions that would be difficult. If this is so then what would be the situation if the problem had referred to spraying over uneven country at varying altitudes in gusty winds? Even to be able to give wide approximations as answers many assumptions would have to be made.

One point which might emerge from some of the answers is that the chances of damage to adjoining crops, to an extent which would matter, may be remote. Suppose the experts considered that under the sets of conditions put forward the answers as to the amount of hormone drift would lie within the following table, expressed as percentages of the amount applied per acre over the target (these figures are entirely hypothetical).

	50 yards	250 yards	500 yards
70 m.p.h. aircraft	1%	.1%	.01%
30 m.p.h. aircraft	.1%	.01%	.001%

In terms of actual weedkiller per acre this would read in grams per acre:

	10 yards	100 yards	1000 yards
70 m.p.h. aircraft	5	.5	.05
30 m.p.h. aircraft	.5	.05	.005

The biologists might possibly then say that tomatoes may be damaged at any rate over 1 gram per acre, lettuces could tolerate anything under 5 grams. and that tulips in flower would be mottled by rates over .5 grams. of MCP but would tolerate slightly more 2,4-D. These figures are only suggestions for the sake of illustration. Possibly answers to these questions have been accurately determined but there is little published information of crop tolerances of this sort. At the 4th International Crop Protection Conference (1957) a paper was given showing that small doses of regulators far from damaging a series of crops actually promoted greater yield and indicated that judicious application of " hormone " might have practical commercial possibilities. But there is no doubt that there is a measurable figure at which worry about drift of hormone weedkillers becomes justified and below which is of no importance. If the suggested figures given earlier happened to be correct or on the right side

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then it is clear that spraying of the weeds from the air with either type of aircraft would be safe as long as there were no tomatoes, lettuce or tulips within 100 yds. Anything beyond that distance could be ignored, and if the particularly susceptible crops were not being grown in the district then it would not really matter what was growing nearby. There are of course other complications such as the possibility of dust whirlwinds which could pick up spray material from the target area, either from the ground or the plants themselves, and carry dangerous quantities perhaps for long distances. The chance of such freak conditions occurring have to be taken into account. Thus if it were possible to spray the target in a way which reduced drift to a level below all crop tolerances within 50 yds. then the operators could go ahead without the need for costly and delaying enquiries before spraying could be begun.

Drift control

Workers on drift problems emphasise the need for large droplets, elimination of fines, slow application speed to reduce turbulence and application at low altitudes above the ground or the crop. At present low, slow flying is expensive and the lower and slower the flying the longer the aircraft is in the air. Detailed study is needed to find out how necessary low, slow flying in different circumstances may be and whether it can be described as an expensive luxury or essential insurance.

Drifting distance of droplets released from a height of 10 *ft. in a* 3 *m.p.h. wind* (*no evaporation*).

Drop size in microns	5	33	100	500
Drifting distance ..	3.5 miles	400 ft.	48 ft.	7 ft.

Where evaporation is high and water must be used, low, slow flying seems to be essential. The possibilities of sudden convection currents or eddies carrying small drops upwards also make it desirable to use the largest drops consistent with satisfactory results, delivered as close to the ground as possible. The biologist's help is needed here, though it is known already that, fortunately, many weeds will be killed or checked by a suitable dose provided it lands anywhere on the plant, complete coverage not being necessary. For such plants sufficient drops to hit each plant at least once is all that is necessary—bigger plants thus automatically getting a larger dose.

With information of this kind available the aerial operators and the aviation industry will have a clear lead as to the most suitable type or types of aircraft needed and some of the controversy on this topic would be cleared up.

The vital aspect of the best type of regulator and its correct formulation to use from the air is still a subject about which too little is known. A good example of how confusion among the experts must bewilder the layman is the question of so-called volatility and non-volatility of weedkillers. The general recommendation which tends to repeatedly be made is that " non-volatile " are safer presumably because the volatile are believed to release vapours which can be deadly at distances from the target. The experimental evidence to support this assertion is scanty and seems largely to be based on small scale laboratory tests which are difficult to relate to field conditions. Others suggest on the contrary, that the " non-volatile " types are more dangerous when applied from the air. This is because, it is presumed, small airborne non-volatile particles retain their identity and finally come to earth virtually unchanged while on the other hand " volatile " particles released in the same way may disappear by evaporation while travelling. On logical grounds the latter view seems to have more to support it. There are few, if any, experimentally proved cases of damage being caused by vapour drift over other than very short distances. Elaborate and expensive experiments would be needed to clear up this and other points of importance. If the immense potential for good which the ability man now has to treat his crops from the air, free from the obstacles and difficulties of the ground is to be fully exploited; and if the array of new chemicals and treatments which are available are to be properly utilised then the problem of drift needs thorough expert study in all parts of the world.

To get the results the agricultural aviation industry needs to help it forge ahead, co-operation is wanted between aircraft manufacturers, engineers, chemists, physicists and biologists. They need to be supported by ample resources and by the assistance of farmers and all concerned with agriculture.

REFERENCES

1. Akesson, N. B. *Drift problems in the application of 2,4D by aircraft.* Report 2nd Agr. Aviation Res. Conf., 1954, pp. 26-33.
2. Courshee, R. J. *Spray drift.* The British Farmer, 4 April, 1959, p. 30.
3. Miller, J. G. and N. S. Mountier. *Aerial top-dressing measurement trials.* N.Z. Jour. Ag. 98 (4), p. 369.
4. Muller, F. B. *The effect of granule size on the efficiency of granulated superphosphate used as a pasture topdressing.* N.Z. Jour. Ag. Res. 2 (1959), 2, p. 234.
5. Yates, W. E. and N. B. Akesson. *Research studies of spray drift from agricultural aircraft.* Publ. Dep. of Agr. Engineering, Univ. of California.
6. Yeo, D. and B. W. Thompson. *Deposition of a coarse Aerosol released from a low flying aircraft.* Nature 4369, Vol. 172 (1953), pp. 168-169.
7. Yeo, D., N. B. Akesson and H. H. Goutts. *Drift of toxic chemicals released from a low-flying aircraft.* Nature, 10 January, 1959, pp. 131-132.

Opossum Eradication Scheme

TWO DISTRICTS of New Zealand have been chosen for a pilot scheme with a view to eradicating the menace of the opossum, an Australian marsupial which was introduced into New Zealand during the last century and now threatens to become almost as great a threat to forest watersheds and so to pastureland as was the rabbit to sheep country.

The districts chosen are Banks Peninsula, on the east coast of the South Island, and Hawkes Bay on the east coast of the North Island.

In each case the experimental schemes are being conducted by the district rabbit boards, which, with other rabbit boards throughout the country, have helped so much to bring New Zealand's rabbit menace largely under control. The New Zealand Minister of Forests, Mr. Eruera Tirikatene, has delegated powers to the two boards chosen under the Noxious Animals Act of 1956, for the destruction and control of opossums.

The project has arisen out of the concern of the New Zealand Forest Service at damage caused by the opossum —a small furry creature with a voracious appetite for herbage.

The Government is paying for the pilot scheme which will last for a year. The boards will be expected to gain information about opossum destruction work and techniques, particularly that applying to pastoral lands, and are each being allocated £5,000 for the purpose. The information it is hoped will be used in a national scheme for opossum destruction, and the two boards are exchanging information on the progress of their work. In Banks Peninsula it is being carried out in an almost sea-girt region of some 60,000 acres.

At present there is a bounty of half a crown a head on opossums, but if eradication is extended as a national policy throughout the country (as was the case with rabbits), it is expected that the bounty scheme will be discontinued.

It has been reckoned that there are at least twenty million opossums in New Zealand—probably many more. Assuming that only twenty-five per cent. of these produced young annually there would be a natural increase of five million. The token system destroys something like one million a year, and trapping for furs possibly another million. This would leave an overall annual increase of at least three million.

The opossum was first liberated in New Zealand about 1860. It is recorded that Sir George Grey, one of New Zealand's early Governors, brought some in and the Auckland, Wellington and Otago Acclimatisation Societies introduced numbers of them between 1870 and 1895. The normal birthrate is one per annum but sometimes animals are observed with twins, and under suitable conditions they will bear twice in one year.

For food there is little in the way of herbage they will not eat, the range covering such different plants as the cabbage tree, mamaku treeferns, beech, nearly all the succulent leaved trees and shrubs, some of which, such as the fuchsias, they will strip bare; they eat leaves, stalk, bark.

Continued defoliation of native trees by opossums end in the death of the trees, and this on a large scale can lead to erosion. Forests inhabited by opossums and other animals such as deer and goats are threatened with extinction. The opossum deals with the tree from the top while the deer, etc. prevent any regeneration on the forest floor. Together they are a perfect team for the destruction of native forests.

Natural vegetative covering on steep hillsides in New Zealand is vital to the country's valuable primary industry—on which the national economy depends—and it is on these steep slopes that opossums wreak their greatest havoc.

They are also extremely destructive in orchards, spoiling very much more than they eat, and chewing out shoots and leaves. Apple trees have scarcely a sound apple left after opossum raids. They eat with relish most garden plants and are especially fond of roses. Farmers' crops, such as maize, peas, swedes, etc., are all grist to the opossum mill, and they destroy many birds eggs. Their competition with native birds for the berries must result in greatly increased mortality among the birds.

For years the opossum was rigidly protected, and even keen observers thought it was not doing the bush any harm; then the cumulative effect of its depredations became apparent and protection was lifted. Subsequently the Government set up a research section and then offered a bounty of two shillings and sixpence for every opossum token surrendered.

Now with the possibility of the adoption of a national eradication scheme, the whole organisation which has been fighting the rabbit menace could be brought to bear on the opossum. Rabbit boards, with a killer policy, are placed strategically throughout the country under a Rabbit Destruction Council. Legislation makes it illegal to trade in rabbit skins or flesh, and even pet rabbits will soon no longer be allowed. All this has resulted in an impressive reduction of the rabbit population of New Zealand by following a plan of systematic rabbit destruction.

NEWS

Celcure form New Company in Australia

News comes from Australia of the expansion of the Celcure organisation for wood preservation through the formation of a new company by Celcure Ltd. of London in conjunction with the Kauri Timber Co. Ltd. of Melbourne. The company will be known as Celcure (Australia) Pty. Ltd., and its registered offices are at 99 Queen Street, Melbourne, C.I.

The formation of this new company comes at a particularly opportune moment in view of the increasing interest that is being shown 'down under' in pressure impregnation as a method of preserving timber. That this interest is matched by demand is reflected by the fact that there are already four Celcure plants installed or in the course of erection in Australia.

The first plant, which was installed by H. Beecham & Co. Ltd., one of the leading Melbourne timber merchants, is already working at full capacity. The Penola Timber Co. Ltd., have just completed the installation of a similar plant at their Mount Gambier premises in the South-east. Further plants are under construction to operate in Sydney and Adelaide.

These Australian plants are designed for working pressures up to 300 lbs. per sq. in., as compared with the usual limit of 200 lbs. in order to obtain improved penetration into resistant timbers such as Douglas Fir. They are also claimed to have the largest diameter cylinders in the Southern Hemisphere, being 8 ft. in diameter. 47 ft. long, they have a capacity of about 1,200 cu. ft. of timber in square stacks on the bogies. Large modern drying kilns are also installed into which the bogies bearing the stacks of treated timber, already suitably lathed, are transferred without any additional handling, thus permitting rapid through-put at a low cost.

These plants are simple and quick to operate. For example, the cylinder despite its size can be filled with 10,000 gallons of preservative in approximately 12 minutes. Operation can be supervised by one man aided only by an alarm system which is designed to sound off during various stages of the process as a safeguard against emergencies.

In addition, to ensure that these plants can be kept in continuous operation they are equipped with a 25,000 gallon storage tank which offers ample capacity for containing the preservative in liquid form. In addition there is a 5,000 gallon mixing tank.

From the point of view of the Australian timber trade this new development is believed to be of considerable importance in that it opens up large markets for some indigenous hardwoods and softwoods previously classed as non-durable, which by this process are rendered suitable for fencing, building and other purposes where long life is required.

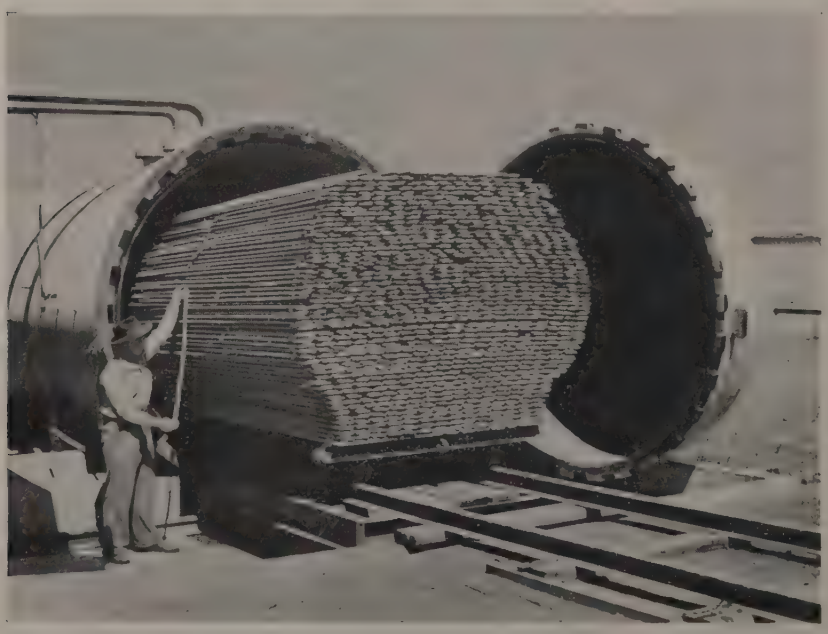
Among the many large projects for which pressure-treated timbers are already being used in Australia are water cooling towers, electricity distributing poles, marine constructions and underground mining timbers, for all of which Celcure has been proved equally suitable on account of its high toxicity to fungal and insect attack and its permanent fixation in the wood.

An interesting development at the Beecham plant is the fact that pressure treatment has now been used successfully on Marine grade plywood which is currently being used in the construction of water cooling towers.

Celcure is a waterborne preservative impregnated into timber at atmospheric temperature. It has as its base either acid-cupric-chromate or copper-chrome-arsenate depending on the mycological and biological conditions prevalent in the countries in which it is used. In Australia where in places there is a considerable termite hazard the latter formulation will be utilised in most instances.

The application of wood preservative in Australia has until comparatively recently been limited to the superficial dipping or brushing of timber. It is claimed that this new development, however, offering facilities for properly controlled vacuum and pressure impregnation together with a well tried preservative, cannot fail to promote confidence in timber preservation which has hitherto been lacking in Australia and this is already demonstrated by the rapidly increasing demand as the new plants come into operation.

This new Company will promote the use of the Celcure process of vacuum and pressure impregnation by timber using industries and arrange the necessary treating facilities at suitably situated plants throughout the country. It will provide technical and other assistance in the installation and operation of these plants and will supply salts to the approved firms licensed to carry out treatment.



Close up showing timber in 8ft diameter cylinder operating at the Melbourne premises of H. Beecham and Co. Ltd.



General view of the Celcure pressure treatment plant installed by H. Beecham & Co. Ltd., one of the leading Melbourne timber merchants

Chairman of the Company is Mr. J. R. Bishop, who is the Chairman of the Kauri Timber Co. and many other Australian companies. Other Directors are Mr. R. J. Taylor, Chief General Manager of the Kauri Timber Co. and all its associated Companies overseas, and Mr. J. S. Elder, a well known Melbourne accountant. The Managing Director is Mr. S. H. Hollick who is also a Director of Celcure Ltd., London.

Celcure plants have been in operation in the U.K. for upwards of 30 years. With the formation of this Company and the rapid expansion in Australia there are now some 81 plants in operation or in course of erection throughout the world. With few exceptions this organisation is administered and controlled by Celcure Ltd., Aldwych House, Aldwych, London, W.C.2.

Appointment of Farm Director to Gleadthorpe Experimental Husbandry Farm

Mr. P. N. Harvey, M.A., Dip. Agric., has been appointed Farm Director at Gleadthorpe Experimental Husbandry Farm, Notts. He will succeed Mr. P. J. Jones, B.Sc., who has been transferred to Bridget's Experimental Husbandry Farm to succeed Mr. W. B. Hay, O.B.E., B.Sc., who retired on 31st December last.

Mr Harvey, at present a Crop Husbandry Advisory Officer in the National Agricultural Advisory Service at the Norfolk Agricultural Station, is 43 years old and a graduate of Emmanuel College, Cambridge, where he also obtained the Diploma in Agricultural Science.

He was an Assistant Field Supervisor 1938 to 1939 and a Field Supervisor 1946 to 1950 at the Norfolk Agricultural Station. In October 1950 he was appointed a Crop Husbandry Advisory Officer and seconded to the Norfolk Agricultural Station. Two years later he was transferred on promotion to Headquarters as Assistant to the Senior Education and Advisory Officer in connection with field experimental work on Experimental Farms and Horticulture Stations. He returned to Norfolk in November, 1955.

Dow Agrochemicals appoints East African Representative

Dow Agrochemicals Limited has appointed Douglas W. Thorne East African representative. The Company, duly registered in Kenya, will be based in Nairobi and sales operations will cover Kenya, Tanganyika and Uganda.

Thorne, Vice-Chairman of the Pesticide Chemicals Association of East Africa since its formation last year, first went to Africa in 1947 as an administrative officer with the Groundnut Scheme. In 1951 he joined the Gold Coast Agricultural Development Corporation on a 25,000 acre resettlement and mechanised agriculture project, and later was associated with the Desert Locust Control. Prior to joining Dow Agrochemicals he was General Manager of Fison's Pest Control (East Africa) Ltd.

The first Dow product to be marketed in East Africa will be Dowpon, the systemic, selective grass weedkiller, which controls couch grass (*Digitaria scalarum*), a limiting factor in African agricultural economy. Beginning this month, Thorne will direct a sales programme for Dowpon through local established East African distributors. Trials will be organised with Ruelene as an anthelmintic spray, and other agricultural chemicals in the Dow range are to follow. These will include soil and grain fumigants. The East African branch will also distribute Cuprovit, the copper oxychloride spray for coffee; Parathion and Metasystox, the systemic insecticide, for Farbenfabriken Bayer.

The offices of the Dow East African branch are located at Lullington House, Queensway, Nairobi, and the postal address is: P.O. Box 9547, Nairobi, Kenya.

Minister comments on Arsenites — Tribute to A.B.M.A.C. and N.F.U.

Concluding his address to the 47th Annual General Meeting of the Somerset National Farmers' Union at Wells on 6th January, 1960, the Minister of Agriculture, Fisheries and Food, the Rt. Hon. John Hare, O.B.E., M.P., said:—

"One of the scientific developments which has helped all of us, horticulturists and farmers, to cut our costs and reduce wastage, has been the increasingly effective chemical sprays. Recently, however, there has been much concern about the use of alkali arsenites. As you know, these are used extensively for killing potato haulms. The potential risks here are particularly wide because of the large number of people involved and the danger to cattle. The Advisory Committee on Poisonous Substances which deals with agriculture and food storage recommended that their use should be voluntarily banned. I held urgent consultations with the Organisations concerned, including of course the N.F.U. I am very glad to be able to tell you that

agreement has now been reached that the manufacture of alkali arsenites for use in this country as haulm destroyers and weedkillers shall now stop, and that after this year's potato harvest the agricultural and ancillary industries will withdraw these arsenites from agricultural use.

"This voluntary ban will not apply to sheep or cattle dips, or to the use of lead arsenate on fruit trees.

"The agreement which we have been able to reach has confirmed my opinion that voluntary arrangements are the best way of looking after matters of this kind. Though the use of these arsenites will continue for another season, I feel that with the support of organisations like the N.F.U. we can make full use of warning publicity to enable us to get through it in safety, and the agricultural chemical manufacturers will be able to push ahead with the development of substitutes.

"This voluntary agreement reflects high credit on all concerned. It inevitably involves some sacrifice by the manufacturers and by the farming community. I should like to pay a sincere tribute in particular to the Association of British Manufacturers of Agricultural Chemicals and to the N.F.U. for the responsible and co-operative way in which they have joined in our negotiations."

Association of Applied Biologists

The following Members of Council retire on 8th April, 1960: Mr. P. Aitkenhead, Dr. Mary T. Franklin, Dr. A. H. M. Kirby and Mr. M. E. Solomon.

British Weed Control Council

The Council will organise a Symposium on "Herbicides and the soil" on Thursday, 7th April, 1960, at 10-30 a.m. in the Clarendon Laboratory, Parks Road, Oxford. The Symposium fee is 10s. Further information can be obtained from Mr. G. R. Sagar, Department of Agriculture, The University, Oxford.

A.A.B. Meetings 1960

Friday, 12 February	"Aspects of crop physiology." Royal Entomological Society, London.
Friday, 11 March	Joint meeting with the British Ecological Society on "Ecological effects of crop production." British Museum (Natural History).
Friday, 8 April (afternoon)	Annual General Meeting. Presidential Address. Metallurgy Lecture Theatre, Imperial College, London.
Friday, 27 May	Spring Meeting at Reading. Visits to The University and N.A.A.S., Coley Park.
Thursday/Friday 22-23 September	Provincial Meeting at the Nottingham University School of Agriculture, Sutton Bonington.
Friday, 14 October	"Soil fauna in relation to soil formation and fertility." British Museum (Natural History).
Friday, 11 November	"Applications of radiation in biology." British Museum (Natural History).
Friday, 9 December	Paper reading meeting. Royal Entomological Society, London.

Agricultural Statistics Advisory Committee

On the expiry of the fourth term of office of the Agricultural Statistics Advisory Committee, appointed by the Minister of Agriculture, Fisheries and Food under the Agriculture Act, 1947, the Minister has appointed the following to be members for a period of three years from 1st January, 1960:

Chairman	Mr. J. H. Kirk, C.B.E., an Under-Secretary of the Ministry.
Representing the interests of farmers	Mr. J. E. B. Davies Mr. J. H. Gray Mr. J. A. Montgomery
Representing the interests of landowners	Sir William Lewthwaite, Bart. Sir William Mount, Bart.
Representing the interests of farmworkers	Alderman C. H. Chandler, J.P. Mr. T. J. Healy.
Other member	Mr. C. J. Brown, Chief Statistician of the Ministry.

All the above have been reappointed.

Mr. Davies has been appointed specially to represent the interests of farmers in Wales.

The Minister has appointed Mr. F. W. German to be the Secretary of the Committee and communications should be addressed to him at the Ministry of Agriculture, Fisheries and Food, Whitehall Place, S.W.1.

The main duties of the Committee are to advise the Minister on the collection of statistical returns from farmers, and related matters such as the drafting of Regulations to be made under Section 78 of the Act.

New Weedkillers for 1960

Farm Protection Ltd., distributors of Du Pont (U.K.) Agricultural Chemicals, are to market two new weedkillers this year. **Tri-Farmon 41** a growth regulating weedkiller based on 2,3,6-Trichlorobenzoic acid, will naturally be used for cereal weed control. It is claimed to control mayweed, cleavers, chickweed, and redshank in addition to all weeds normally controlled by MCPA.

The above company are also to market **Residuren** which is a mixture of herbicides including diuron, a product of Du-Pont (U.K.) Ltd. This residual herbicide, by correct application can be used for the control of weeds in peas, tick beans, broad beans and bulbs. Further information can be obtained from the above company at Hull Bridge Mills, Beverley, Yorkshire.

New Electric Potato Blight Predictor

The Electrical Development Association have developed a potato blight predictor, and electrically operated instrument which provides an audible and visible warning that the humidity in the area has reached a dangerous figure. The advantages of spraying with fungicides at the right time are well known, and the use of this device is claimed to obviate unnecessary spraying. With the cost of spraying at approximately £2 per acre, one unnecessary spraying would cover the cost of the instrument (£55) on a reasonable size crop.

New Control for Codling Moth

The Murphy Chemical Co. Ltd., have announced that they will be marketing a new formulation of Crag Brand Sevin containing 50% of 1-napthyl N-methylcarbamate.

Sevin acts as a stomach and contact poison and is reported to have a much lower manmation toxicity than DDT. It is said to have an advantage over DDT and Lead

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Arsenate in that it will kill the Codling Moth Caterpillar even after the Caterpillar has just penetrated the skin of the fruit. Sevin can be used pre-blossom in place of BHC/DDT for Appid and Caterpillar control.

Sevin must not be applied between late pink bud and the end of the first week in June. Also as this chemical does not control Red Spider it may be necessary to use other chemicals for this purpose at the appropriate time.

Foot and Mouth — African Virus spreads from Research Institute

An outbreak of foot-and-mouth disease was confirmed among cattle at Worplesdon, Guildford, Surrey, on 18th January. The routine laboratory examination of material from the affected animals has shown that the virus is an African type (S.A.T.2). As this type is being used at Pirbright in important experiments on the development of vaccines on behalf of Commonwealth and other countries in Africa, the Ministry has attributed the cause of the outbreak to an escape of virus from the Animal Virus Disease Research Institute at Pirbright. This Institute is independent with its own governing body, but it is financed by and under the general control of the Agricultural Research Council.

An investigation into the apparent failure of the strict security arrangements maintained at the Institute is now being undertaken.

Although an African virus was found to be the cause, the effect on susceptible animals is the same as it is with European types of the virus and the stamping out policy is equally effective in eradicating it. All the animals on the affected farm were slaughtered on 18th January.

Rodent Control in Plantations

In our article " Some Harmful Mammals " which was published in our December issue, we gave brief mention to the use of Endrin and Toxaphene for the control of the short tailed vole, *Microstis agrestis* L. The Standardised Disinfectants Co. Ltd., have supplied us with further information on this matter with a leaflet entitled: " Technical Information Sheet No. 5/6—Toxostan for Rodent Control " which is available to interested parties. The following extracts are taken from this leaflet.

" Excellent control of rodents by spraying with toxaphene has recently been achieved in the U.S.A. and Germany whilst Toxastan, a highly concentrated formulation of toxaphene, manufactured by Standardised Disinfectants Co. Ltd., has proved highly effective against voles in the U.K.

" In the United States the use of toxaphene for controlling field mice in orchards has been investigated by the Washington State College. It was found that 12 lbs. per acre is the dosage required for effective control. If, however, the cover between rows of trees is worked up by beating, cutting or discing, then spraying can be concentrated on tree rows and good results are obtained with 6 lbs. of toxaphene per acre. The toxaphene is dispersed in water before spraying and is applied at 50-300 gallons per acre, using conventional equipment with spray booms or hand guns. Aerial spraying has not proved very effective. Road edges, ditch banks and border areas as well as the orchard itself should be sprayed. The treatment remains effective for 4-6 weeks but treatment of border areas 3-4 weeks after the original spraying may keep orchards free from infestation for a longer period.

" In Great Britain Toxostan (SDC toxaphene formulation) has been tried for the control of voles damag-

ing young timber belts on the Earl of Lonsdales Estates with complete success. Four pints of Toxastan (= 4 lbs. toxaphene) in 60 gallons of water were applied per acre with a tractor-drawn agricultural sprayer and 21 acres were treated in two days. The treated area which was fenced off was completely free of voles within three days of spraying. Three dead rabbits and one hare were also found within the fenced area.

" Indications from other research in Great Britain are that 3 pints of Toxastan per acre would have been an adequate doseage.

" This technique of rodent control is new and care should be taken with its application and we recommend that local Agriculture and Forest Officers be taken into consultation at this stage."

Pest Technology hope that anyone thinking of applying toxaphene for rodent control will pay strict attention to the precautions given by the manufacturers.

Industrial Pest Control Association Film Show

" No Trouble In Store," " The Challenge " and " The Pyrethrum Story " were the titles of three 16 mm. sound and colour films shown to members of the Industrial Pest Control Association at the Hotel Rembrandt, South Kensington on on Tuesday, 19th January. These films were made by member companies of the IPCA.

" No Trouble In Store " demonstrated very effectively how pests such as grain weevils, Ephestia moths, spider beetles, cockroaches and blow-flies destroy and contaminate vast quantities of food. The film showed how, by methods of hygiene and the use of insecticides, food wastage could be avoided and food could be maintained in a sound condition. An excellent example was the protection of bacon against blow-flies.

In contrast, " The Challenge " told the formidable story of the rat which can be found wherever there are human beings. This artistic documentary showed how and why rats exist, why they can only be exterminated successfully if their suspicion is allayed, and why effective control requires the skill of the expert who understands their habits.

The third film, " The Pyrethrum Story " told how the pyrethrum flower is grown in Kenya and other equatorial countries, and is there harvested and processed to produce a highly effective insecticide which is harmless to humans, animals, birds, and fish. The film also showed how Kenya has prospered as a result of the pyrethrum industry.

These three films may be borrowed free of charge, and applications should be made to the following companies: " Trouble in Store "—Cooper, McDougall & Robertson Ltd., Berkhamstead, Herts. " The Challenge " — Disinfestation Ltd., Felcourt, East Grinstead, Sussex. " The Pyrethrum Story "—African Pyrethrum Technical Information Centre Ltd., 4 Grafton Street, London, W.1.

Notes from the N.F.U. Annual Report for 1959

Parliamentary Committee on Wood Pigeons and Rabbits

The Government accepted a suggestion by the Chairman of the Committee that wood pigeon nest destruction could be carried out by Rabbit Clearance Societies and the expense incurred in doing so would qualify for the £ for £ grant. The Committee welcomed this further contribution in the battle against wood pigeons, but emphasised that the most effective means of controlling them was by expert shots or by organised shoots. It was regretted that experiments to discover a safe but effective narcotic had proved disappointing.

The formation and work of Rabbit Clearance Societies—at 7th December there were 352 societies covering an area of 6.03 million acres—is going ahead fairly well, but there were signs by the middle of the year that rabbits were again resurgent in some areas and doubts were expressed in Wales whether the existing method of control by means of purely voluntary boards and the existing level of grant were themselves sufficient to counter the spread of the pest. Meeting in October, the Committee felt it premature either to condemn voluntary societies as failures or to urge the Government to introduce legislation for the establishment of compulsory rabbit clearance boards on the basis of local option—a suggestion which had been explored with counties but rejected two years before, although it was now favoured by some Welsh Counties. Equally, it was felt that no evidence had accumulated to show whether a 50% subsidy was in fact insufficient inducement to membership of societies in some areas. The Committee continued to press the Government to remove the vested interest from rabbits entirely by banning their sale, and regretted that it had not apparently been found possible to overcome the practical difficulties in the way of enforcement before such a policy could be recommended to Parliament.

Central Horticultural Committee.
Aerial Spraying

Discussion took place on the problems created by the aerial spraying of crops and arrangements were made for the Committee to be represented on a sub-committee which met the National Association of Agricultural Contractors. Discussion had taken place on the question of how the aerial application of crop protection products might be regulated, with a view to the prevention of damage resulting from the drift of sprays or dusts. There has been a general feeling that legislation on this matter was inevitable in due course but in the meantime steps should be taken to devise a suitable code of practice. Further information is awaited on the formulation of such a code.

Horticultural Development and Education Sub-Committee.
Spray Drift Damage

The difficulties growers experience in obtaining compensation for damage done to crops by hormone weedkillers has again occupied a considerable proportion of the sub-committee's time. As a sales levy on these herbicides is impracticable, the sub-committee considers that a Ministerial committee of enquiry is the right approach. It is therefore gratifying to learn that the Minister has asked Lord Waldegrave to make a special study of the whole problem. At the time of preparing this report the Union was preparing evidence for Lord Waldegrave's committee.

Development and Educational Committee

The use of arsenite sprays as potato haulm killers has been increased in recent years, but during 1958 there were a number of cases of fatal poisoning among livestock which had gained access to sprayed crops. A meeting was held with the Association of British Manufacturers of Agricultural Chemicals with a

view to finding means of preventing such unfortunate occurences. The manufacturers agreed to intensify their search for an acceptable non-poisonous chemical defoliant and it is hoped that such a product will be available commercially by 1961.

In the meantime, however, it was agreed that further emphasis should be given to the poison warnings on the labels of containers and that publicity should be given to the need for particular care in the use of arsenical products. During the summer of 1959 a joint declaration on the subject was put out by the N.F.U., the National Association of Corn and Agricultural Merchants and the Association of British Manufacturers of Agricultural Chemicals, setting out precautions need to be taken in the use of these products.

Nevertheless, an unfortunate accident occurred during the 1959 season, when the water supply to two farms became contaminated with an arsenical product used for spraying potatoes. This case has aroused considerable public concern and the Minister has been considering a proposal to ban the manufacture and use of sodium and potassium arsenite for agriculture. While looking forward to the time when these products will no longer be required, the Union is concerned that at the present time there is no satisfactory alternative available, and in the absence of efficient haulm killers in a wet season the results on the potato crop could be disastrous.

Regarding the declaration of active ingredients in spray chemicals the Committee has continued to be concerned that declarations should be given on containers and in the technical literature stating the active ingredients in crop protection products, and it has been supported in this by many resolutions from many county branches.

So far as the two major types of herbicides, MCPA and 2,4-D, are concerned, it is now a condition of inclusion in the Crop Protection Products Approval Scheme that such declarations should be given, and members are advised wherever possible to select products from the approved list.

The Association of British Manufacturers of Agricultural Chemicals has now agreed to recommend to its members that the name of the active ingredient of all pest control products should be included on the label, together with any brand name, and it is hoped that this will help to reduce the confusion caused by the multiplicity of chemical products now available. Details of the percentage of active ingredients would, it is claimed, be misleading in view of the differences in formulation and problems of analysis.

The Ministry is now reviewing the Crop Protection Products Approval Scheme, and the Union has been consulted on proposals for its improvement.

Glasshouse Produce Committee

The above committee report that in the early part of the year many complaints were received of damage to plants in glasshouses, particularly lettuce, following the application of certain new chemical soil sterilisers. The reports indicated that the growers found great difficulty in negotiating terms of compensation with the manufacturers and distributors of the sterilisers concerned for the loss of their crops. The Committee therefore appointed a delegation to meet representatives of the soil steriliser manufacturers and distributors with a view to obtaining an improvement in the position. These discussions were most helpful.

PUBLICATIONS RECEIVED

Agricultural Aviation. Vol. 1, No. 4 *Published by the European Agricultural Aviation Centre, The Hague, Netherlands.*

The aim of the E.A.A.C. is that via this periodical interested parties such as manufacturers of agricultural chemicals, manufacturers of aircraft, operators, government officials, research institutes etc., will be kept informed of new technical developments, new types of aircraft with the application equipment going with them, agricultural chemicals and other related information.

Although published by the E.A.A.C. *Agricultural Aviation* includes information from all corners of the globe and is available on a world wide basis. This attractive issue contains articles on agricultural aviation in Turkey, Italy and Yugoslavia, together with an article on drift, which is reproduced in this issue of *Pest Technology*, in addition there are descriptions of a new type of agricultural aircraft and equipment and extracts from recent agricultural aviation literature, which should provide a useful guide to further information.

As this is only the fourth issue of this publication and as agricultural aviation can still be regarded as in the early development stages in many countries it would, perhaps, be precocious to venture a definite opinion as to the status of this publication. However, the high technical backing of *Agricultural Aviation* suggests that as the use of aircraft in agriculture increases—and surely it will—so this journal will become a most valuable addition to our bookshelves.

Classification of Wood Preservatives and their Methods of Application. B.S. 1282:1959.
Published by the British Standards Institution, 2 Park Street, London, W.1. Price 6/-.

Anyone who has had to refer to a British Standard in the course of their work will know that in preparation these publications are subjected to discussion, criticism and a great deal of thought by authorities in the particular field which is being dealt with. Upon the issue of these publications the only course open to the reviewer is to announce the availability of the publication and give some indication of the content matter. Usually the reviewer is also relieved of this latter task by the Standard's foreword which succintly summarises the contents.

This generalisation applies in this case thus:—

"The 1945 edition of this British Standard, entitled 'Classification of Wood Preservatives,' gave descriptions of the various types of wood preservatives, together with limited notes as to their use and method of application. To make this revision as useful as possible, it has been decided that it should provide not only a classification of wood preservatives but also a guide to their methods of application.

"*This standard is a guide and classification only, and should not be used or quoted as a specification.*

A form of words indicating that a preservative treatment conforms to B.S. 1282 *should not be used as it conveys no meaning.*

" This standard concerns the preservation of timber in the United Kingdom against wood destroying fungi, insects and marine borers. It indicates the main hazards, classifies suitable preservatives and methods of application and outlines the remedial measures to be taken where untreated or inadequately treated timber has been attacked after being put into use. It gives references to related British Standards, a Code of Practice (CP 112.100) and other publications containing more detailed information. It does not deal with the protection of timber against fire or mechanical damage, immunisation of newly felled timber in the forest, or hazards not encountered in this country, e.g. termites, nor with the methods of reducing the decay of untreated timber by means of seasoning, ventilation and painting."

Little need be added to this description except, perhaps, the facts that preservatives have been grouped into tar oil types, organic solvent types and water borne types. Three appendices give information on the resistance of the heartwood of some common woods to impregnation with preservatives, a list of naturally durable woods and a bibliography of detailed information on the subject.

Agricultural Improvement Council—Fourth Report — 1956-59.
Published by Her Majesty's Stationery Office, price 2*s.* 0*d.*

The Fourth Report of the Agricultural Improvement Council shows the variety of technical problems with which the present-day farmer and scientist have to deal, and tells how the Council is helping to tackle them.

The Report gives a good deal of attention to the work of the Ministry's Experimental Husbandry Farms and Horticultural Stations, and summarises the work being done. Many hundreds of experiments mostly long term, are being carried out in an attempt to solve urgent and important farming problems. These experiments range from selection for beef production, calf rearing methods grass conservation and glasshouse construction, heating and ventilation. For those interested in crop protection, we would draw their attention to the following paragraphs:—

Paragraph 12 indicates that there is a need for more animal and potato growing research and although well covered more research on certain problems e.g. eelworm, is required. Paragraph 46 refers to the difficulties of controlling weed and eelworm pests of bulbs.

Paragraphs 82 and 83, are concerned with apple scab, 84 with diseases of mushrooms and 85 with black currant gall mite.

The bracken problem is dealt with in paragraph 97 and it is said that research is being continued on chemical methods of control and several promising spray materials are being tried out.

Spray drift damage to crops again comes in for some attention in paragraphs 105, 106 and 107.

In paragraphs 109 and 110, dealing with harmful birds and mammals it has been shown that " both rats and foxes have some hitherto unsuspected sources of food. Rats will readily subsist on plant roots, seeds, earthworms, and snails; and foxes, showing the same kind of adaptability, will readily take plant food such as berries in addition to live animals and carrion." Of the bird pests, it has been shown that the destruction of wood pigeon nests, if done efficiently and on a co-operative basis in late summer, is a useful additional method for controlling these birds; work on narcotised bait has been unpromising. The bullfinch can be readily trapped by the correct use and siting of cage traps.

From paragraphs 111, 112 and 113 it is evident that nematodes are still a serious problem. The potato root eelworm is still a constant irritant to our export trade and the pea root eelworm has risen in importance following the rapid increase in the acreage of peas grown for processing, canning and freezing. The Lucerne stem eelworm is perhaps an even more serious potential danger than pea root eelworm, but the number of field cases is as yet relatively small and the prospects of dealing with it satisfactorily are brighter.

The last two paragraphs in the Report, numbers 117 and 118, dealing with slugs and the Frit fly respectively show that damage by slugs to agricultural crops has been giving increasing concern in recent years and the amount of damage caused to wheat is comparable to that caused by the wheat bulb fly. The problem has been referred to the A.R.C. for consideration as to what further research may need to be undertaken. The Frit fly, in addition to causing losses to oats running into several millions of pounds per year, attacks a number of cultivated grasses and it is a potentially serious adverse factor in the establishment of new leys.

Land 7. Winter 1959-1960
Published by Shell Chemical Co. Ltd.

This issue of " Land " is as always, well produced, and contains the usual articles of general interest to the countryman. The first article in this issue entitled " A.B.M.A.C.—How it Works," should be of great value in correcting some of the exaggerated beliefs held by some of the wealthier countrymen, who believe that agricultural chemicals, are used indiscriminately and without thought any side effects that they may have. By reading this article even the disbelievers will surely realise that pesticides are not used on a " hit or miss " basis and that members of A.B.M.A.C. take every precaution to ensure the safety and safe use of their products.

Also included in this issue of " Land," is an article on " The Chemical Control of Plant Eelworms " which may be of interest to Pest Technologists.

Control of Pests, Diseases and Weeds in Vegetables and Soft Fruit Grown for Canning, Quick Freezing and Processing.
Published by the Murphy Chemical Co. Ltd., Wheathamstead, Herts.

The purpose of this booklet is described in the rather imposing title. It could well prove to be a useful addition to the library of any grower in this field.

The greater part of this booklet is comprised of a number of tables intended to give growers of crops for quick freezing, canning and processing, a guide to the control of the pests, weeds and diseases most likely to occur. From these tables the grower will be able to map out a control programme for the year.